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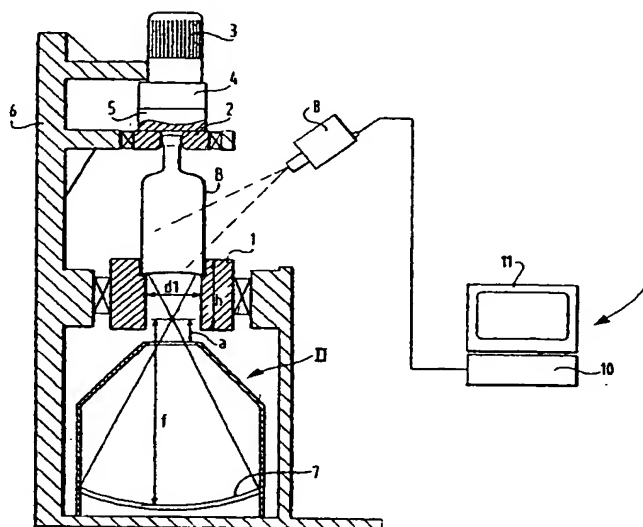
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(54) Title: METHOD FOR INSPECTING OF A TRANSPARENT PACKAGING AND APPARATUS AND SYSTEM TO BE  
USED THEREWITH

(57) Abstract: The present invention relates to a method for inspecting packagings of transparent material, such as for food or pharmaceutical products, wherein light is radiated into the packaging by a light source, wherein images of the illuminated packaging are recorded by a camera and wherein the images recorded by the camera are processed, wherein the light source comprises a number of approximately point-like light sources arranged a short distance from each other, in addition to focussing means for focussing the beam generated by the point-like light elements of small dimensions.

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— *Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**METHOD FOR INSPECTING OF A TRANSPARENT PACKAGING,  
AND APPARATUS AND SYSTEM TO BE USED THEREWITH**

In the none too distant past problems occurred at a known Dutch brewery because fragments of glass were found to be present in filled beer bottles. Although this was caused by the quality of the glass used, the glass bottle  
5 packaging for beer and other drinks has hereby been placed in an unfavourable light.

Known from the international patent application PCT/NL96/00049 are a method and device for detecting extremely small glass fragments in filled beer bottles.  
10 Each filled bottle is herein rotated in a separate station for a short time and then quickly decelerated, whereby the small glass fragments are set into motion and can be detected using a light source camera system and associated image processing.

15 Although the results in a test arrangement are favourable such that this method and device will be carried out in practice at a speed of 1000 bottles per minute in an existing bottling-line of a brewery, it is a problem in such an industrial environment to radiate  
20 light of sufficient intensity into the bottom of the bottle.

The present invention provides a method for inspecting packagings of transparent material, such as for food or pharmaceutical products, wherein light is  
25 radiated into the packaging by a light source, wherein images of the illuminated packaging are recorded by a camera and wherein the images recorded by the camera are processed, wherein the light source comprises a number of approximately point-like light elements of small  
30 dimensions arranged a short distance from each other, in addition to focussing means for focussing the beam generated by the point-like light sources.

Owing to the large light output of the light beam, such a method can be applied in an industrial surrounding.

It is noted that the European patent application EP  
5 A 0 775 927 describes an optical illumination system for xerographic printers, wherein in use is made of about 25 LEDs in a closed environment.

In the preferred embodiment use is made of LEDs with a small exit angle whereby the light concentration is  
10 further increased. LEDs are now available with an exit angle of 4-6°, while in the future LEDs will be available with an exit angle of 1 to 2°.

For application in detecting contamination in a bottle filled with liquid, a wavelength of about 590 nm  
15 is preferably used, as this is suitable for transmission through both green and brown glass.

The present invention further provides a device for illuminating a relatively small area with a relatively high intensity, comprising:

20 - a number of approximately point-like light sources arranged at a short distance from each other, wherein the number is in the order of magnitude of 100 or more and wherein a light intensity in the order of magnitude of 10,000 lux or more is generated.

25 The LEDs have a long lifespan and are particularly suitable for emitting light beams of high intensity for a short time. The lifespan of such LEDs is not adversely affected by this pulsation, in contrast to halogen lighting and the like.

30 The detection method as described in the above stated prior art publication makes use of illumination from the underside of the bottle. The light source according to the present invention can however likewise be disposed opposite a camera, while it is perhaps also  
35 conceivable to place the camera on the underside. Owing to the high intensity of the light source with focussing, such arrangements can certainly not be precluded.

Further advantages, features and details of the present invention will be elucidated on the basis of the following description of a preferred embodiment thereof, with reference to the annexed drawing, in which:

5       fig. 1 shows a schematic view of an inspection station according to the present invention;

          fig. 2 is a cross-sectional view of detail II of fig. 1; and

          fig. 3 is a top view of detail III of fig. 2.

10       A beer bottle B (fig. 1) is clamped in each case between a ring 1 and a head 2 and rotated rapidly and subsequently decelerated by a motor 3, which is coupled to head 2 via a gearing mechanism 4 and a brake 5. Ring 1 and head 2 are therefore mounted rotatably relative to a  
15 frame 6. In each case as soon as the bottle is decelerated, light is projected from a light source 7 into the bottle and the movements of possible contaminants in the liquid are transmitted to an image processing station 9 using a CCD-camera 8, wherein they  
20 can be made visible on a screen 11 by a processor 10.

          The opening in head 1 has a diameter  $d_1$  of 45-50 mm, while the head has a height (h) of about 75 mm. In order to project sufficient light through this opening, the focal point of the beam is situated at a distance a of  
25 25-30 mm relative to a housing 12 of light source 7. In this preferred embodiment the focal length f amounts to about 185 mm.

          Although it is conceivable to have focussing take place with a lens, for instance using a flat Fresnel  
30 lens, the light source 7 (fig. 2) is provided in the present invention with a flat window 21 of translucent material, preferably of hard and scratch-resistant material, whereby light source 7 is extremely robust. This is further provided with an inclining upper wall 22,  
35 whereby moisture and/or dirt in an industrial environment

will not adversely affect the intensity of the light source.

In this preferred embodiment (fig. 3) a large number of LEDs 31, in the present embodiment about 350, are placed in a spherical holder 32, whereby a focussing action is obtained. The LEDs have a small exit angle in the order of magnitude of  $6^\circ$ , while in the future it will become possible to achieve an exit angle of 1 to  $2^\circ$ . In order to obtain as optimal a transmission as possible for green and brown bottles, LEDs with a wavelength of 590 nm are preferably utilized.

In a manner not shown the interior of the housing in which the light source is accommodated can be provided with air cooling, wherein feed of cooled air and discharge of air can take place along a cable bushing in the housing required for the electrical connections.

A light-sensitive detector can further be arranged between the LEDs or on the rear side of the light source in order to measure the light intensity of the quantity of light emitted by the LEDs in a determined environment, and to regulate the power supply to the LEDs subject thereto so as to obtain the desired quantity of light in the space.

It will be apparent that the present invention can be applied in all conceivable forms of inspection and the like, from full to empty packagings wherein concentrated light is desired.

The present invention is not limited to the above described preferred embodiment thereof, the rights sought being rather defined by the following claims, within the scope of which many modifications can be envisaged.

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## CLAIMS

1. Method for inspecting packagings of transparent material, such as for food or pharmaceutical products, wherein light is radiated into the packaging by a light source, wherein images of the illuminated packaging are recorded by a camera and wherein the images recorded by the camera are processed, wherein the light source comprises a number of approximately point-like light sources arranged a short distance from each other, in addition to focussing means for focussing the beam generated by the point-like light elements of small dimensions.

2. Method as claimed in claim 1, wherein the packaging is a bottle filled with liquid and wherein the bottle is rotated and decelerated.

3. Method as claimed in claim 1 or 2, wherein the bottle is clamped between a head and a lower ring with a central recess, and wherein the focal point of the light source is set close to the bottom edge of the central recess.

4. Device for illuminating a relatively small area with relatively high intensity, comprising:

- a number of approximately point-like light sources arranged at a short distance from each other, wherein the number is in the order of magnitude of 100 or more; and
- a light intensity in the order of magnitude of 10,000 lux or more is generated.

5. Device as claimed in claim 4, wherein the focussing means comprise a Fresnel lens.

6. Device as claimed in claim 4, wherein the focussing means comprise a holder in which the light sources are arranged and the form of which is such that a focussing action is obtained.

7. Device as claimed in claim 6, wherein the form of the holder is substantially spherical.

8. Device as claimed in any of the foregoing claims, wherein the light sources comprise light-emitting diodes (LEDs) with a relatively small exit angle.

9. Device as claimed in claim 5, wherein the exit angle amounts to less than  $10^\circ$ , preferably  $4-6^\circ$ , or less.

10. Device as claimed in any of the foregoing claims, wherein the wavelength of the light to be emitted by the light source has an order of magnitude of about 600 nm, amounts preferably to about 590 nm.

11. System for detecting contaminants in a bottle filled with liquid, wherein the bottle is rotated and decelerated, and wherein the system comprises:

15 - a light source for radiating light into the bottle,

- a camera for recording images of moving contaminants in the liquid, and

20 - an image processing device for processing the images coming from the camera, wherein a device as claimed in any of the claims 4-10 is applied.

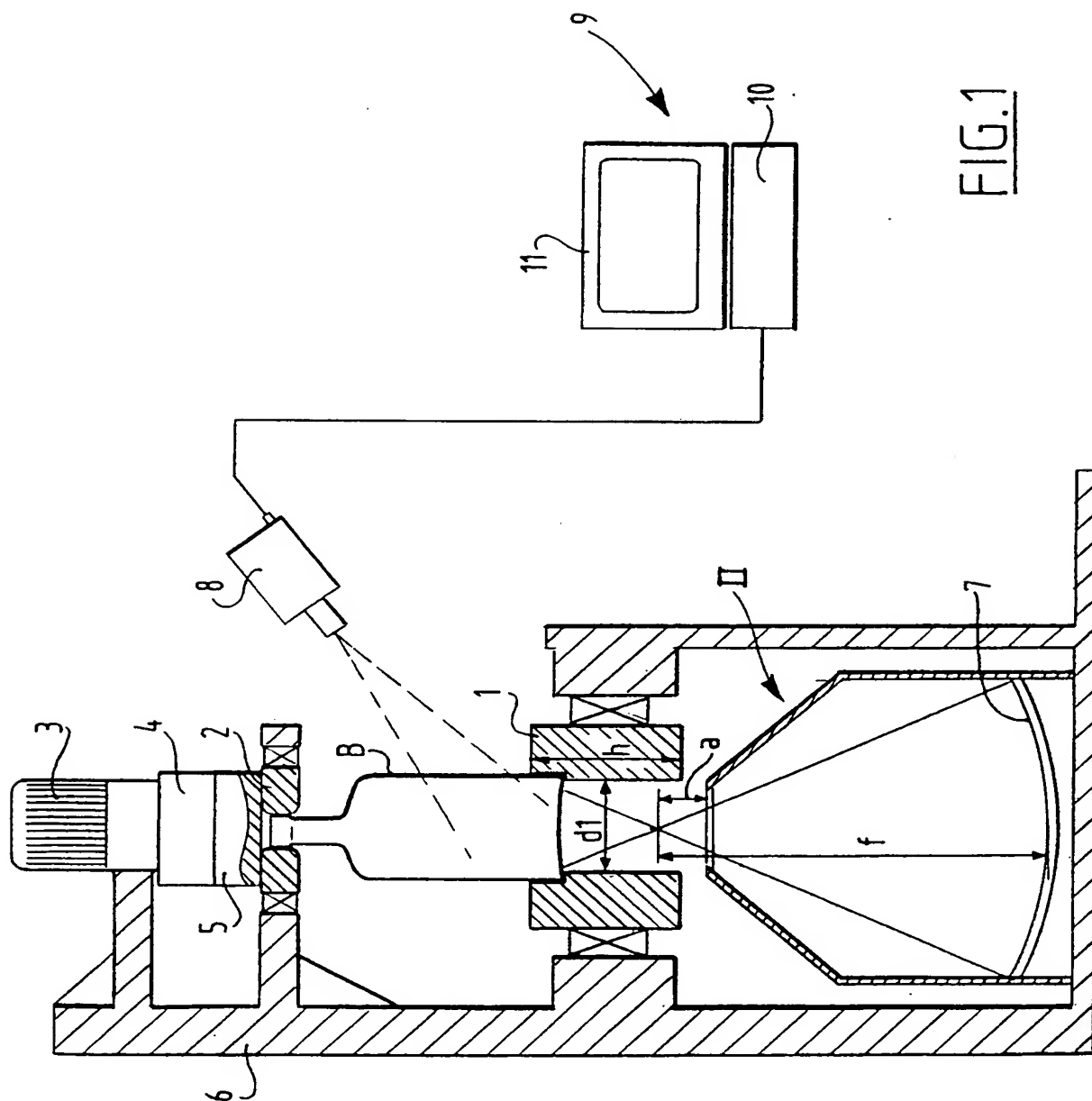
12. System as claimed in claim 8, wherein the bottle is clamped between a head and a lower ring with a central recess, and wherein the focal point of the light source is located close to the bottom edge of the central recess.

13. Method for detecting contaminants in a bottle filled with liquid, wherein a system as claimed in claim 8 or 9 is applied and/or a light source as claimed in one or more of the claims 1-7.

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2/3

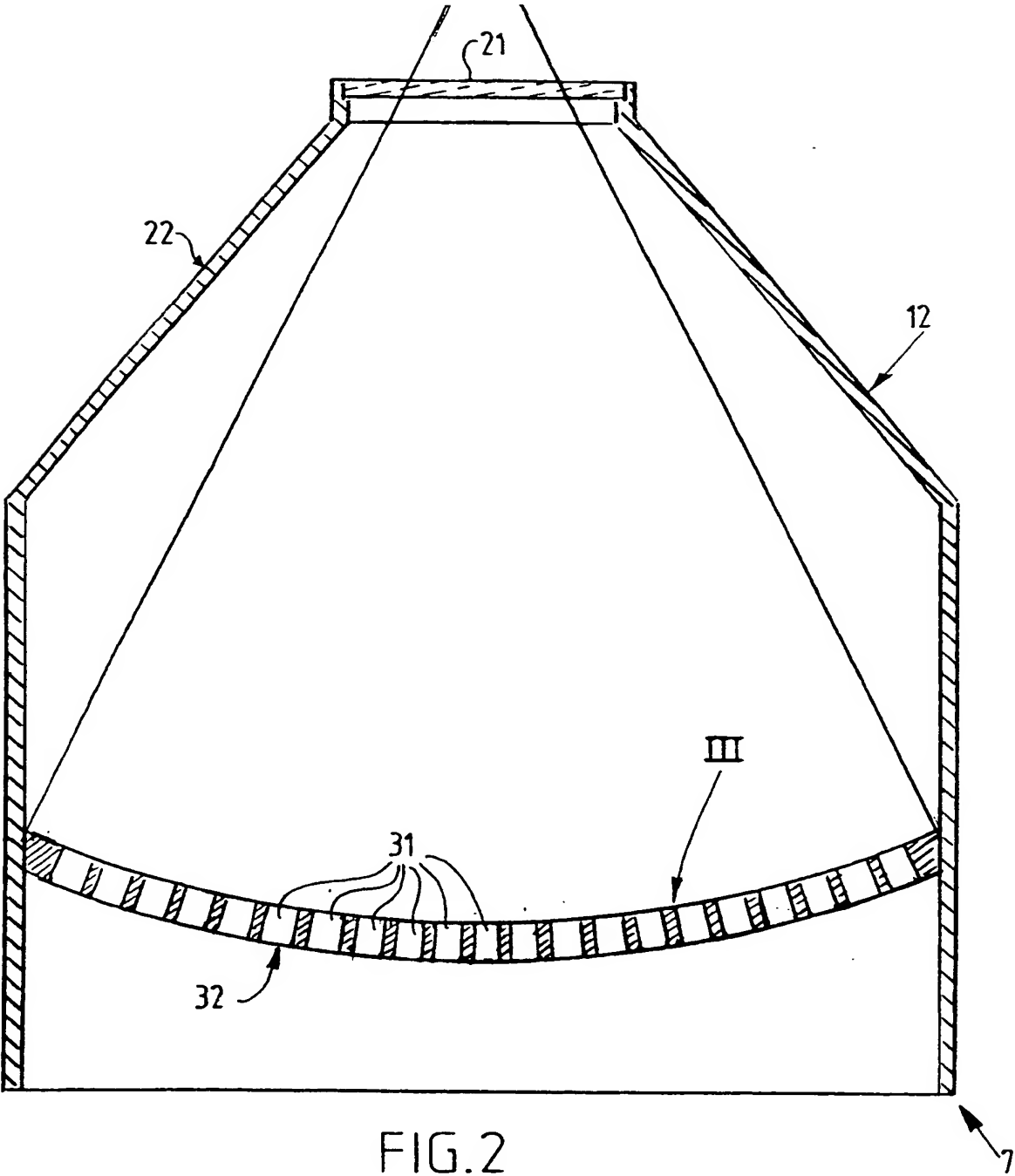


FIG. 2

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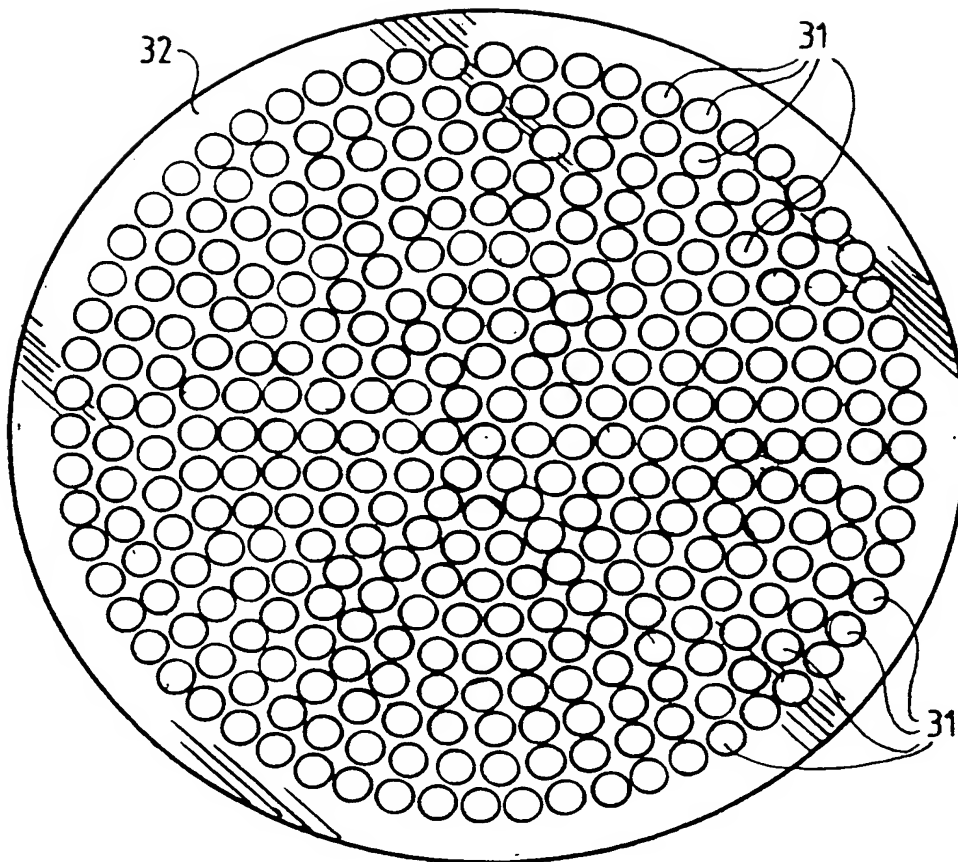


FIG. 3

# INTERNATIONAL SEARCH REPORT

Int'l Application No

PCT/NL 00/00410

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G01N21/90 G01N21/88

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01N B07C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC, COMPENDEX

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 195 14 271 A (KETTNER VERPACKUNGSMASCHF) 24 October 1996 (1996-10-24)	1
Y	abstract column 1, line 60 -column 2, line 32	2
Y	WO 97 14956 A (HEINEKEN TECH SERVICES ;CRONSHAW ANTHONY JAMES (GB); HODGES CHRIST) 24 April 1997 (1997-04-24) cited in the application page 5, line 19 -page 6, line 9 figure 1	2
	-/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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# INTERNATIONAL SEARCH REPORT

International Application No.

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	BRUNI S: "Stadium illumination for the World Cup football matches" ELETTRIFICAZIONE, FEB. 1999, UTET PERIODICI SCIENTIFICI SRL, ITALY, vol. 49, no. 2, pages 70-74, XP000949943 ISSN: 0013-6093 the whole document	4
P,X	TAMURA T ET AL: "Illumination characteristics of lighting array using 10 candela-class white LEDs under AC 100 V operation" INTERNATIONAL CONFERENCE ON LUMINESCENCE AND OPTICAL SPECTROSCOPY OF CONDENSED MATTER, OSAKA, JAPAN, 23-27 AUG. 1999, vol. 87-89, pages 1180-1182, XP000955678 Journal of Luminescence, May 2000, Elsevier, Netherlands ISSN: 0022-2313 abstract	4,8,10
X	YASUMOTO M ET AL: "Compact, high-illuminance LED linear light source" SANYO TECHNICAL REVIEW, DEC. 1992, JAPAN, vol. 24, no. 3, pages 68-79, XP000949888 ISSN: 0285-516X abstract	4,8
Y		5,6,9,10
Y	US 5 690 417 A (CHOATE ALBERT G ET AL) 25 November 1997 (1997-11-25) abstract	5,6,9
A	column 5, line 8 - line 15 figures 1-3	4
A	EP 0 775 927 A (TEXAS INSTRUMENTS INC) 28 May 1997 (1997-05-28) cited in the application page 6, line 38 - line 53 figures 6,7	4-7
Y	US 5 864 395 A (LAURBERG CLAUS KIRKEGAARD) 26 January 1999 (1999-01-26) abstract column 3, line 32 - line 35 column 5, line 8 - line 11 figure 5	10

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/NL 00/00410

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19514271 A	24-10-1996	NONE	
WO 9714956 A	24-04-1997	AU 712622 B AU 4845996 A BR 9610939 A CA 2234217 A CN 1200175 A EP 0858595 A JP 11513799 T	11-11-1999 07-05-1997 02-03-1999 24-04-1997 25-11-1998 19-08-1998 24-11-1999
US 5690417 A	25-11-1997	DE 19653234 A FR 2748577 A JP 10054940 A	20-11-1997 14-11-1997 24-02-1998
EP 0775927 A	28-05-1997	JP 9251134 A	22-09-1997
US 5864395 A	26-01-1999	AU 4253996 A BR 9509999 A CA 2207710 A WO 9618883 A EP 0797767 A	03-07-1996 30-12-1997 20-06-1996 20-06-1996 01-10-1997